

**CLAIM AMENDMENTS****Claims pending:**

- At time of the Office Action: Claims 1-56.
- After this Response: Claims 1-56.

**Cancelled claims:** none.**Amended claims:** 24-26, 31-33, and 40.**New Claims:** none.

Please amend claims 24-26, 31-33, and 40 as follows:

1. **(ORIGINAL)** In a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes each characterized by characteristic data, a method for determining which of the shapes are intersected by the ray, the method comprising:

defining a reference object relative to the represented object;  
determining the positions of the shapes relative to the reference object using the characteristic data; and  
determining, on the basis of the positions of the shapes relative to the reference object, those shapes that have no chance of intersecting the ray, and those remaining shapes that may intersect the ray.

2. **(ORIGINAL)** The method of claim 1 further comprising using a predetermined algorithm to determine which one of those remaining shapes intersects the ray.

1  
2 3. (ORIGINAL) The method of claim 1, wherein the collection of  
3 shapes comprises at least one polygonal shape.

4  
5 4. (ORIGINAL) The method of claim 1, wherein the collection of  
6 shapes comprises a plurality of polygonal shapes.

7  
8 5. (ORIGINAL) The method of claim 1, wherein the collection of  
9 shapes comprises at least one triangle.

10  
11 6. (ORIGINAL) The method of claim 1, wherein the collection of  
12 shapes comprises a plurality of triangles.

13  
14 7. (ORIGINAL) The method of claim 1, wherein the collection of  
15 shapes comprises a triangle mesh.

16  
17 8. (ORIGINAL) The method of claim 1, wherein the collection of  
18 shapes comprises a triangle strip.

19  
20 9. (ORIGINAL) The method of claim 1, wherein the collection of  
21 shapes comprises a triangle fan.

22  
23 10. (ORIGINAL) The method of claim 1, wherein said reference object  
24 comprises at least one plane.  
25

1 11. (ORIGINAL) The method of claim 1, wherein said reference object  
2 comprises a plurality of planes each of which contain the ray.

3  
4 12. (ORIGINAL) The method of claim 1, wherein said determining the  
5 positions of the shapes comprises determining positional aspects of sub-  
6 components of individual ones of the shapes to provide the characteristic data.

7  
8 13. (ORIGINAL) The method of claim 12, wherein the individual  
9 shapes comprise polygons and the sub-components comprise vertices that define  
10 the polygons, said determining the positions of the shapes comprising computing  
11 the positions of the vertices relative to the reference object.

12  
13 14. (ORIGINAL) The method of claim 13, wherein the reference object  
14 comprises a plane.

15  
16 15. (ORIGINAL) The method of claim 14, wherein the plane is parallel  
17 to one of the  $x$ ,  $y$ , and  $z$  axes.

18  
19 16. (ORIGINAL) In a computer graphic processing system in which a  
20 ray is cast toward an object represented by a collection of pre-determined shapes, a  
21 method for determining which of the shapes are intersected by the ray, the method  
22 comprising:

23 defining a collection of polygons that approximate an object, individual  
24 polygons having a plurality of vertices;

25 casting a ray toward the approximated object;

1 defining a reference object relative to the collection of polygons and that  
2 contains the cast ray;

3 pre-characterizing at least some vertices of at least some of the polygons to  
4 provide characteristic data that describes the vertices' positions relative to the  
5 reference object; and

6 using the characteristic data to ascertain the positions of the individual  
7 polygons relative to the reference object.

8  
9 17. (ORIGINAL) The method of claim 16, wherein the collection of  
10 polygons approximate the surface of the object.

11  
12 18. (ORIGINAL) The method of claim 16, wherein the individual  
13 polygons have a similar geometry.

14  
15 19. (ORIGINAL) The method of claim 16, wherein the individual  
16 polygons comprise triangles.

17  
18 20. (ORIGINAL) The method of claim 16, wherein the collection of  
19 polygons has a plurality of faces and a plurality of vertices, said faces  
20 outnumbering said vertices.

21  
22 21. (ORIGINAL) The method of claim 16, wherein at least two of said  
23 polygons share at least one side.

1 22. (ORIGINAL) The method of claim 16, wherein at least two of said  
2 polygons share at least one vertex.

3  
4 23. (ORIGINAL) The method of claim 16, wherein none of said  
5 polygons share a vertex.

6  
7 24. (CURRENTLY AMENDED) ~~The method of claim 16,~~ In a  
8 computer graphic processing system in which a ray is cast toward an object  
9 represented by a collection of pre-determined shapes, a method for determining  
10 which of the shapes are intersected by the ray, the method comprising:

11 defining a collection of polygons that approximate an object, individual  
12 polygons having a plurality of vertices;

13 casting a ray toward the approximated object;

14 defining a reference object relative to the collection of polygons and that  
15 contains the cast ray;

16 pre-characterizing at least some vertices of at least some of the polygons to  
17 provide characteristic data that describes the vertices' positions relative to the  
18 reference object; and

19 using the characteristic data to ascertain the positions of the individual  
20 polygons relative to the reference object, wherein said using of the characteristic  
21 data comprises determining whether an individual polygon is in a sub-set of  
22 polygons that might be intersected by the ray.

23  
24 25. (CURRENTLY AMENDED) ~~The method of claim 16,~~ In a  
25 computer graphic processing system in which a ray is cast toward an object

1 represented by a collection of pre-determined shapes, a method for determining  
2 which of the shapes are intersected by the ray, the method comprising:

3 defining a collection of polygons that approximate an object, individual  
4 polygons having a plurality of vertices;

5 casting a ray toward the approximated object;

6 defining a reference object relative to the collection of polygons and that  
7 contains the cast ray;

8 pre-characterizing at least some vertices of at least some of the polygons to  
9 provide characteristic data that describes the vertices' positions relative to the  
10 reference object; and

11 using the characteristic data to ascertain the positions of the individual  
12 polygons relative to the reference object, wherein said using of the characteristic  
13 data comprises determining whether an individual polygon is in a sub-set of  
14 polygons at least some of which straddle the reference object.

15  
16 26. (CURRENTLY AMENDED) ~~The method of claim 16, In a~~  
17 computer graphic processing system in which a ray is cast toward an object  
18 represented by a collection of pre-determined shapes, a method for determining  
19 which of the shapes are intersected by the ray, the method comprising:

20 defining a collection of polygons that approximate an object, individual  
21 polygons having a plurality of vertices;

22 casting a ray toward the approximated object;

23 defining a reference object relative to the collection of polygons and that  
24 contains the cast ray;

25

1 pre-characterizing at least some vertices of at least some of the polygons to  
2 provide characteristic data that describes the vertices' positions relative to the  
3 reference object;

4 using the characteristic data to ascertain the positions of the individual  
5 polygons relative to the reference object, wherein said using of the characteristic  
6 data comprises determining whether an individual polygon is in a sub-set of  
7 polygons at least some of which straddle the reference object, ~~and further~~  
8 ~~comprising; and~~

9 evaluating the sub-set of polygons to determine which polygons are  
10 intersected by the ray.

11  
12 27. (ORIGINAL) In a computer graphic processing system in which a  
13 ray is cast toward an object represented by a collection of pre-determined shapes, a  
14 method for determining which of the shapes are intersected by the ray, the method  
15 comprising:

16 defining a plurality of triangles that approximate an object, individual  
17 triangles having three vertices;

18 casting a ray toward the approximated object;

19 defining at least one plane relative to the approximated object to contain the  
20 ray;

21 pre-characterizing the vertices of the plurality of triangles to provide  
22 characteristic data that describes the positions of the vertices relative to said at  
23 least one plane; and

24 using the characteristic data to ascertain the positions of the individual  
25 triangles relative to said at least one plane.

1  
2 28. (ORIGINAL) The method of claim 27, wherein said defining of  
3 said plurality of triangles comprises defining a triangle mesh.

4  
5 29. (ORIGINAL) The method of claim 27, wherein said defining of  
6 said plurality of triangles comprises defining a triangle fan.

7  
8 30. (ORIGINAL) The method of claim 27, wherein said defining of  
9 said plurality of triangles comprises defining a triangle strip.

10  
11 31. (CURRENTLY AMENDED) ~~The method of claim 27, In a~~  
12 computer graphic processing system in which a ray is cast toward an object  
13 represented by a collection of pre-determined shapes, a method for determining  
14 which of the shapes are intersected by the ray, the method comprising:

15 defining a plurality of triangles that approximate an object, individual  
16 triangles having three vertices;

17 casting a ray toward the approximated object;

18 defining at least one plane relative to the approximated object to contain the  
19 ray;

20 pre-characterizing the vertices of the plurality of triangles to provide  
21 characteristic data that describes the positions of the vertices relative to said at  
22 least one plane; and

23 using the characteristic data to ascertain the positions of the individual  
24 triangles relative to said at least one plane, wherein said using of the characteristic  
25



1 data comprises determining whether a particular individual triangle has a chance  
2 of being intersected by the ray.

3  
4 32. (CURRENTLY AMENDED) ~~The method of claim 27,~~ In a  
5 computer graphic processing system in which a ray is cast toward an object  
6 represented by a collection of pre-determined shapes, a method for determining  
7 which of the shapes are intersected by the ray, the method comprising:

8 defining a plurality of triangles that approximate an object, individual  
9 triangles having three vertices;

10 casting a ray toward the approximated object;

11 defining at least one plane relative to the approximated object to contain the  
12 ray;

13 pre-characterizing the vertices of the plurality of triangles to provide  
14 characteristic data that describes the positions of the vertices relative to said at  
15 least one plane; and

16 using the characteristic data to ascertain the positions of the individual  
17 triangles relative to said at least one plane, wherein said using of the characteristic  
18 data comprises determining whether a particular individual triangle straddles said  
19 at least one plane.

20  
21 33. (CURRENTLY AMENDED) ~~The method of claim 27,~~ In a  
22 computer graphic processing system in which a ray is cast toward an object  
23 represented by a collection of pre-determined shapes, a method for determining  
24 which of the shapes are intersected by the ray, the method comprising:

1 defining a plurality of triangles that approximate an object, individual  
2 triangles having three vertices;  
3 casting a ray toward the approximated object;  
4 defining at least one plane relative to the approximated object to contain the  
5 ray;  
6 pre-characterizing the vertices of the plurality of triangles to provide  
7 characteristic data that describes the positions of the vertices relative to said at  
8 least one plane;  
9 using the characteristic data to ascertain the positions of the individual  
10 triangles relative to said at least one plane, wherein said using of the characteristic  
11 data comprises defining a sub-set of triangles at least some of which straddle the  
12 plane, and further comprising; and  
13 evaluating the sub-set of triangles to ascertain which triangles are  
14 intersected by the ray.

15  
16 34. (ORIGINAL) The method of claim 27, wherein none of the  
17 triangles share any vertices.

18  
19 35. (ORIGINAL) The method of claim 27, wherein all of the triangles  
20 share at least one vertex with another of the triangles.

21  
22 36. (ORIGINAL) The method of claim 27, wherein said defining of  
23 said at least one plane comprises defining a plane to be parallel to one of the x, y,  
24 or z axes.  
25

1 37. (ORIGINAL) In a computer graphic processing system in which a  
2 ray is cast toward an object represented by a collection of pre-determined  
3 polygons, a method for determining which of the polygons are intersected by the  
4 ray, the method comprising:

5 defining a sub-set of polygons from a collection of polygons that  
6 approximate an object by determining which polygons have vertices that satisfy a  
7 predefined relationship relative to a reference object; and

8 evaluating the sub-set of polygons to ascertain which of the polygons is  
9 intersected by a cast ray.

10  
11 38. (ORIGINAL) The method of claim 37, wherein the reference object  
12 comprises a plane.

13  
14 39. (ORIGINAL) The method of claim 37, wherein the reference object  
15 comprises multiple planes.

16  
17 40. (CURRENTLY AMENDED) ~~The method of claim 37, In a~~  
18 computer graphic processing system in which a ray is cast toward an object  
19 represented by a collection of pre-determined polygons, a method for determining  
20 which of the polygons are intersected by the ray, the method comprising:

21 defining a sub-set of polygons from a collection of polygons that  
22 approximate an object by determining which polygons have vertices that satisfy a  
23 predefined relationship relative to a reference object, wherein the reference object  
24 comprises a plane; and  
25

1 evaluating the sub-set of polygons to ascertain which of the polygons is  
2 intersected by a cast ray,

3 wherein ~~the reference object comprises a plane,~~ and said determining  
4 comprises determining which polygons straddle the plane.

5  
6 41. (ORIGINAL) One or more computer-readable media having  
7 computer-readable instructions thereon which, when executed by a computer,  
8 implement the method of claim 37.

9  
10 42. (ORIGINAL) A programmable computer having a memory and a  
11 processor, the memory containing software code which causes the processor to  
12 execute the method of claim 37.

13  
14 43. (ALLOWED ORIGINAL) A computer graphic processing system  
15 comprising a programmable computer programmed with computer-readable  
16 instructions which, when executed by the programmable computer, implement the  
17 following method:

18 defining a plurality of polygons that approximate an object, individual  
19 polygons having a plurality of vertices;

20 casting a ray toward the approximated object;

21 defining at least one plane relative to the approximated object to contain the  
22 ray;

23 pre-characterizing the vertices of the plurality of polygons to provide  
24 characteristic data that describes the positions of the vertices relative to said at  
25 least one plane;

1 using the characteristic data to ascertain the positions of the individual  
2 polygons relative to said at least one plane;

3 determining which of the individual polygons might be intersected by the  
4 ray, based upon their ascertained positions, to provide a sub-set of polygons; and

5 evaluating the sub-set of polygons to ascertain which of the polygons are  
6 intersected by the ray.

7  
8 44. (ALLOWED ORIGINAL) The computer graphic processing  
9 system of claim 43, wherein said defining of the plurality of polygons comprises  
10 defining a polygon mesh.

11  
12 45. (ALLOWED ORIGINAL) The computer graphic processing  
13 system of claim 43, wherein said defining of the plurality of polygons comprises  
14 defining a polygon fan.

15  
16 46. (ALLOWED ORIGINAL) The computer graphic processing  
17 system of claim 43, wherein said defining of the plurality of polygons comprises  
18 defining a polygon strip.

19  
20 47. (ALLOWED ORIGINAL) The computer graphic processing  
21 system of claim 43, wherein said defining of said at least one plane comprises  
22 defining said plane to be parallel to one of the x, y, and z axes.  
23  
24  
25

1 48. (ALLOWED ORIGINAL) One or more computer-readable media  
2 having computer-readable instructions thereon which, when executed by a  
3 computer graphic processing system, implement the following method:

4 defining a plurality of triangles that approximate an object, individual  
5 triangles having three vertices;

6 casting a ray toward the approximated object;

7 defining at least one plane relative to the approximated object to contain the  
8 ray;

9 pre-characterizing the vertices of the plurality of triangles to provide  
10 characteristic data that describes the positions of the vertices relative to said at  
11 least one plane;

12 using the characteristic data to ascertain the positions of the individual  
13 triangles relative to said at least one plane;

14 determining which of the individual triangles might be intersected by the  
15 ray, based upon their ascertained positions, to provide a sub-set of triangles; and

16 evaluating the sub-set of triangles to ascertain which of the triangles are  
17 intersected by the ray.

18  
19 49. (ALLOWED ORIGINAL) The one or more computer-readable  
20 media of claim 48, wherein said defining of the plurality of triangles comprises  
21 defining one of a triangle mesh, a triangle strip, and a triangle fan.

22  
23 50. (ORIGINAL) A computer graphic processing system comprising:  
24 a processor;  
25 memory; and

1 software code stored in the memory that causes the processor to implement  
2 a ray-intersection algorithm which:

3 casts a ray at a collection of shapes that approximate an object;

4 defines a reference object that contains the ray;

5 pre-characterizes aspects of individual ones of the shapes of the collection  
6 to provide characteristic data; and

7 uses the characteristic data to ascertain the position of the shapes of the  
8 collection of shapes relative to the reference object.

9  
10 51. (ORIGINAL) The computer graphic processing system of claim 50,  
11 wherein the ray intersection algorithm casts a ray at a collection of polygons, each  
12 of which have similar geometries.

13  
14 52. (ORIGINAL) The computer graphic processing system of claim 50,  
15 wherein the ray intersection algorithm casts a ray at a collection of triangles.

16  
17 53. (ORIGINAL) The computer graphic processing system of claim 52,  
18 wherein the collection of triangles defines a triangle mesh.

19  
20 54. (ORIGINAL) The computer graphic processing system of claim 50,  
21 wherein the ray intersection algorithm pre-characterizes aspects of the shapes by  
22 computing positions of various sub-components of the shapes relative to the  
23 reference object.  
24  
25

55. (ORIGINAL) The computer graphic processing system of claim 54,  
wherein the reference object comprises at least one plane.

56. (ORIGINAL) The computer graphic processing system of claim 55,  
wherein the shapes comprise polygons and the sub-components comprise vertices  
of the polygons.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25